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Emergency Approach: Cleaning and Rehabilitation of Hand- Dug Well in Civil Engineering Department, Federal Polytechnic Ede, Nigeria

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Abstract
Water is one of the basic necessities of life and good drinking water is of paramount importance to health. This work was carried out as an emergency approach in cleaning and rehabilitating a hand dug well in Civil engineering department of The Federal Polytechnic Ede in order to ameliorate WASH operation during the COVID 19 pandemic. Also returning the hand dug well to its former condition before the man-made disaster. Four step approach was used which includes, Inventory of the existing well; Rehabilitation and cleaning of the well; Disinfection of the well and lastly, Dewater the well. The water quality parameters examined on the field were PH (using a pocket size PH meter) and Turbidity (using locally available materials like a clean oil drum with minimum depth of 50cm, a bucket, a copper coin with diameter of 2.5cm and a steel tape measure for estimation of a reasonable NTU). However, other physico-chemical analysis were done under laboratory conditions to determine whether/ not the water sample conformed to the global (WHO) and (SON) standards requirement for potable (safe drinking) water. Consequent upon test, it was observed that the water sample showed conformity to the standards requirements with respect to the PH value and Turbidity both for field test and laboratory analysis. The PH for the field test is 7.2 while the Turbidity is less than 5NTU. In respect to the laboratory analysis, the PH, Turbidity, Colour, Temperature, Chlorine residual, Total hardness, Alkalinity, Chloride, Calcium ions, Total dissolved solids, Nitrate, Nitrite, Sulphate, Iron, Zinc, Nickel all conformed to the standards requirements. All the physico-chemical parameters gave a wholesome and reasonable permissible limit making the water good and acceptable for the emergency usage. Also the hand dug well was returned to its former condition. The institution and the department should support further measures for permanent rehabilitation of the hand dug well making it fit for consumption thereby facilitating more operation of WASH.
Keynote: Hand-dug well, Rehabilitation, Cleaning, WASH.
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INTRODUCTION

Water is one of the basic necessities of life and good drinking water is of paramount importance to health (Steven, 2018). Reliable access to clean and affordable water is considered one of the most basic humanitarian goals and remains a major global challenge for the 21st century. Our current water supply faces enormous challenges worldwide; some 780 million people still lack access to improved drinking water sources (WHO, 2011).

In 2010, the UN General Assembly voted that access to clean drinking water and sanitation is a basic human right (Sveriges, 2010). In total, there are about 1.8 billion people worldwide who drinks water from an unsafe water source. By having access to clean drinking water and proper sanitary equipment as well as knowledge of hand hygiene, the mortality can be decreased (WHO, 2016a).

One major source of water in South West Nigeria is hand - dug wells. Flooring, civil unrest and other natural and man -made disasters often cause damage to hand - dug wells. This disasters renders the hand- dug wells unsuitable access to a safe, clean water and sanitation. This technical work sets out actions taken to repair and rehabilitate a hand- dug well in Civil Engineering Department of Federal Polytechnic Ede to return the well to its former good condition. The emergency repair and rehabilitation was done to ameliorate WASH operation during the COVID-19 pandemic within the institution and produce water of good quality.

2.0. MATERIALS AND METHODS

Four steps approach was used which includes;
Inventory of the existing well
Rehabilitation and cleaning of the well

Disinfection of the well
Dewater of the well

2.1. Inventory of the Existing Well

The hand dug well was located in the quad angle of Civil Engineering Department of The Federal Polytechnic Ede, South Campus. The well was dug during the construction of Civil Engineering department by the co tractor. The well was an open line surface well used as source of water for the construction. It also serve as source of water for the department when the facility was completed and handed over to Civil Engineering Department. The major source of contamination of the hand dug well is surface water, debris, poor construction and unhygienic method of collection of water.

2.2. Rehabilitation and cleaning of the well

The rehabilitation and cleaning was based on the amount of damage caused by the disaster. The following steps were taken during the cleaning and rehabilitation;
The polluted water and debris were removed from the well using buckets.
The well walls were repaired and another well ring of 600mm was placed on top to reduce sub-surface contamination.
Cleaning of the well lining was done using a long handled brush and chlorinated water.
A 150mm layer of gravel was placed at the base of the well to prevent it from disturbance.
A 150mm thick concrete cover with opening in the middle of the cover was provided for the well and head wall around the well was constructed to prevent surface water.
The turbidity and PH of the well water was checked. The turbidity was greater than 5NTU after cleaning and rehabilitation stage. So all the water in the well were removed and the well was allowed to refill with water and the test on turbidity was done again which gives <5NTU.

2.3. Disinfection of the well

Disinfection was recommended to ensure well components are hygienically clean. HSCH chlorine powder was used due to its wide availability.
Calculation of the chlorine dosage for disinfection
Equipment - 20 liter bucket and HSCH chlorine powder.
Method- The volume of the water in the well was calculated using the formula;

$$V=\frac{\pi D^2 h}{4}$$

Where, V= volume of water in the well (m^3)
D= diameter of the well (m)
h= depth of water (m)
π= 3.142

The bucket was filled with clean water from the well. 500g of HSCH was added and stir until it dissolved. Normally 250g needed to be added but since we are using the solution for cleaning the well linings, the quantity of HSCH was doubled. Therefore, for every cubic meter of water in the well 10 liters of the chlorine solution was added and used in cleaning of the well linings. The water in the well was thoroughly stirred with a long pole and was allowed to stand for at least 30 minutes to measure the chlorine concentration.

2.4. Dewater the Well

Following the contact period and the chlorine concentration all the water in the well was removed. When the well refilled, the water was allowed to stand for another 30 minutes and the chlorine concentration was measured. This process was repeated until the residual chlorine concentration was less than 0.5mg/l.

3. RESULTS AND DISCUSS

From the results of the project the hand dug well was returned to a better condition. The results of the physic-chemical test and Bacteriological test on the water sample are shown in Table 2 and Table 4 respectively which indicates that all the parameters tested for are within WHO standard and SON standard.

In accordance with the World Health Organization (WHO, 2011) water quality guideline values, the Most Probable Number (MPN) in any portable water should not be detectable in 100ml i.e. 0/100ml. Table 3 showed that the well water have 180^+ MPN before the rehabilitation and cleaning but after the rehabilitation and cleaning the Well water reduced to 90MPN.

4. CONCLUSION AND RECOMMENDATION

Good water quality is of great importance. In view of the evaluation carried out, all the physico-chemical

parameters gave a wholesome and reasonable permissible limit making the water good and acceptable for the emergency usage. Plate 1-3 shows the water serving the purpose of Hand washing during the COVID-19 pandemic in the Department of Civil Engineering Federal Polytechnic Ede, South Campus.

From the result, it can be recommended that the institution and the department should support further measures for permanent rehabilitation of the hand dug well making it fit for consumption. Also, WASH operation should be facilitated the more.

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Table 1: Results of Physic-Chemical Test on Well Water Samples before Rehabilitation and Cleaning

PARAMETERS (mg/L)	WELL SAMPLE	WHO Standard	Nigerian Standard
Appearance	Not Clear	Clear	Clear
Colour (H.U)	150	15	15
pH at Laboratory	7.2	6.5-8.5	6.5-8.5
Temperature	28.50	Ambient	Ambient
Turbidity	146	5	5
Dissolved oxygen	2.4	NA	NA
Total Alkalinity	216	500	500
Total Hardness	88	500	500
Calcium Hardness	44	300	300
Calcium ions	16.4		
Magnesium Hardness	35	150	150
Magnesium ions	10		
Chloride ion	20	250	250
Iron	0.28	0.3	0.3
Silica	0.25		
Total non-filt solid	307.5	600	600
Conductivity (µs/cm)	316.9	1000	1000
Flocculation	20		
Carbonate CO_3^{2-}	150		
Bicarbonate HCO_3^-	550	NA	NA

Table 2: Results of Physic-Chemical Test on Well Water Samples after Rehabilitation and Cleaning

PARAMETERS (mg/L)	WELL SAMPLE	WHO Standard	Nigerian Standard
Appearance	Clear	Clear	Clear
Colour (H.U)	10	15	15
pH at Laboratory	7.2	6.5-8.5	6.5-8.5
Temperature	29	Ambient	Ambient
Turbidity	4.01	5	5
Dissolved oxygen	2.4	NA	NA
Total Alkalinity	116	500	500
Total Hardness	46	500	500
Calcium Hardness	40	300	300
Calcium ions	16.20		
Magnesium Hardness	32	150	150
Magnesium ions	08		
Chloride ion	16	250	250
Iron	0.25	0.3	0.3
Silica	0.22		
Total non-filt solid	241.4	600	600
Conductivity (µs/cm)	316.9	1000	1000
Flocculation	10.00		
Carbonate CO_3^{2-}	120.00		
Bicarbonate HCO_3^-	488.00	NA	NA

Table 3: Results of Bacteriological Test on Well Water Samples before Rehabilitation and Cleaning

Sample Description	pH	Colonies per CC Growing On Nutrient Agar at 37°C in 24hours	Presumptive results of Coliform Organism at 48°C Hours of Incubation at 37°C	Most Probable Number of Bacteria Coliform Per 100ml of Water Sample
WELL WATER	7.2	89	155	180

Table 4: Results of Bacteriological Test on Well Water Samples after Rehabilitation and Cleaning

Sample Description	pH	Colonies per CC Growing On Nutrient Agar at 37°C in 24hours	Presumptive results of Coliform Organism at 48°C Hours of Incubation at 37°C	Most Probable Number of Bacteria Coliform Per 100ml of Water Sample
WELL WATER	7.2	48	153	90

Plate 1: Student on the Queue Practicing Hand Washing

Plate 2: Hand Washing during Covid-19 Pandemic

Plate 3: WASH in Practice